(14) (2) If a target object is a three-dimensional object and has a depth and an uneven surface pattern, the appearance (area, shape, and the like) of the object changes in different directions.

(15) (3) If a target object is not a perfectly rigid object (e.g., a man wearing clothing), the shape of the object changes at each time point.

(16) (4) If a portion of a background and a portion of a target object have the same color or luminance, the same color or luminance portion of the target object is not detected as a changing area while the target object passes through the same color or luminance portion of the background.

(17) In the states wherein corresponding changing areas are not necessarily detected at each time point as described above, since corresponding changing areas may not be present, moving vectors may not be obtained. Therefore, the block association processing scheme may not properly function. If the block association processing scheme fails or does not properly function as described above, serious problems are posed when it is applied to a monitoring system (display monitoring system).

(18) In order to solve the above-described problems, a tracking means capable

DISPLAY MONITORING SYSTEM FOR DETECTING AND TRACKING AN INTRUDER IN A MONITOR AREA

BACKGROUND OF THE INVENTION

Find what: color

Area: All, Sel/Cur | Direction: Up, Down | Match word: Whole, Part | Look in: Left, Right, Grid, Documents | Match ca

FULL

EAST Browser - L11: (1) "5243418".PN. | US 5243418 A | Tag: S | Doc: 1/1 | Format : FULL

File Edit View Tools Window Help

(94) (4) In the above embodiments, changes are considered only in terms of brightness. However, a method of detecting changes on the basis of changes in color or texture may be simply used depending on an application. If it is known in advance that a target object has a specific color, a change can be reliably detected by detecting a change in color or by assemblying a plurality of change detections. In this case, depending on a target object, a change can be properly detected only by certain processing. In such a case, the method used in the change detection should be transferred to the tracking step so that tracking processing is also performed in consideration of the used method, thus improving the reliability of processing.

(95) (5) In the above embodiments, only the sizes of changing areas are taken into consideration to determine which one of the areas is to be tracked. However, if a changing area is selected in consideration of information about the shapes of changing areas in addition to their sizes, a target can be more reliably selected. Since the contour of a still object tends to be mistaken for a changing portion due to the difference between the contour and the background, the following processing may be additionally performed: removing edges such as the contour mentioned above, or neglecting changes occurring at

FULL

5,243,418

1

DISPLAY MONITORING SYSTEM FOR DETECTING AND TRACKING AN INTRUDER IN A MONITOR AREA[SIC]

BACKGROUND OF THE INVENTION

2

Find what: color

Area: All, Sel/Cur | Direction: Up, Down | Match word: Whole, Part, Left, Right | Look in: Grid, Documents | Match ca

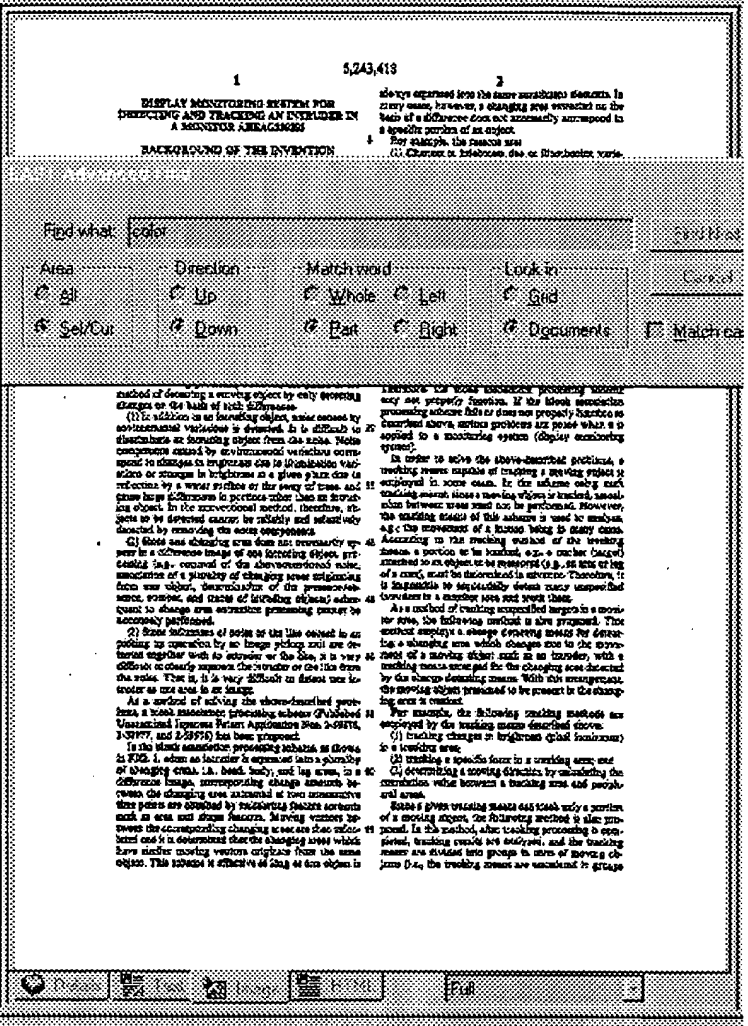
Full

unit. In this case, it serves as a module for tracking an object and extracting its contour.

(109) Modifications of the candidate extraction processing performed by the candidate extracting section 440 will be described below.

(110) (1) Only information relating to the moving path of each tracking unit, such as position and speed information of each tracking unit within an image, is used to the estimation function used for candidate extraction processing. However, feature amounts of, e.g., color and shape, obtained from the tracking area of each tracking unit may be added to the information. Assume that a plurality of tracking units are concurrently tracking body portions of an intruder in red clothing. If the process for determining the identity of the intruder is additionally performed upon extraction of color information from the tracking area of each tracking unit, a candidate can be easily extracted by associating the information from the tracking unit.

(111) (2) The estimation function used for calculating the association strengths between the tracking units in candidate extraction processing may be replaced with the process for extracting a candidate for a moving object by using knowledge associated with the positions



5,243,418

1

DISPLAY MONITORING SYSTEM FOR DETECTING AND TRACKING AN INTRUDER IN A MONITOR AREA(S)

BACKGROUND OF THE INVENTION

2

Find what: color

Area: All, Sel/Cur — Direction: Up, Down — Match word: Whole, Part — Look in: Left, Right, Grid, Documents

Match ca

EAST Browser - L11: (1) "5243418".PN. | US 5243418 A | Tag: S | Doc: 1/1 | Format : FULL

File Edit View Tools Window Help

associating the information from the tracking unit.

(111) (2) The estimation function used for calculating the association strengths between the tracking units in candidate extraction processing may be replaced with the process for extracting a candidate for a moving object by using knowledge associated with the positions and speeds of tracking units, attribute values such as the colors and shapes of changing areas which are being tracked, and the preset shape and movement information of an intruder.

(112) An example of this processing will be described below. Processing modules are prepared. Each module compares the respective information described above between two tracking units and converts the comparison result into numerical values indicating whether the compared information are close to each other (i.e., moving objects resemble each other or the same moving object is tracked). Output results from the respective processing modules may be simply added together. Alternatively, the priorities of the respective information are determined, and a weighted sum obtained by weighting in accordance with the priorities is used as an association strength. For example, by using information associated with the shape of an intruder, the probability of obtaining an accurate result

5,243,418

1

DISPLAY MONITORING SYSTEM FOR DETECTING AND TRACKING AN INTRUDER IN A MONITOR AREA

BACKGROUND OF THE INVENTION

2

Find what: color

Area: All, Sel/Cur

Direction: Up, Down

Match word: Whole, Part, Left, Right

Look in: Grid, Documents

Match ca

112 explain 111

processing.

(113) (3) Each candidate list formed by the candidate extracting section 440 need not be constituted by only a group of tracking units but may include the overall position information of the candidates and attribute values such as color and shape information obtained from areas to which the tracking units are assigned. In this case, feature extraction processing is performed in addition to candidate extraction processing so that when candidate are extracted by the candidate extraction processing, feature information can be simultaneously extracted from areas in an image in which the candidates exists. The extracted feature information is then added to the candidate information to form a candidate list. If additional attribute values are included in candidate data, association processing is facilitated by adding the process for determining the similarity of attribute values to the process for associating candidates in the result interpreting section 450. In addition, the reliability of the association processing result is increased. The feature extraction processing need not be included in the candidate extraction processing but may be performed parallel as independent processing so that the feature extraction processing can be sequentially performed in response to requests from the candidate extraction processing.

1

DISPLAY MONITORING SYSTEM FOR DETECTING AND TRACKING AN INTRUDER IN A MONITOR AREA

BACKGROUND OF THE INVENTION

2

Find what: color

Area: All, Sel/Cur | Direction: Up, Down | Match word: Whole, Part, Left, Right | Look in: Grid, Documents | Match ca

method of detecting a moving object by only moving changes or the lack of such differences.

(1) In addition to an intruding object, noise caused by environmental variations is detected. It is difficult to distinguish an intruding object from the noise. Noise components caused by environmental variations consisted in changes in brightness due to illumination variations or changes in brightness at a given place due to reflection by a wear surface or the sway of trees, and 15 cause large differences in portions other than an intruding object. In the conventional method, therefore, objects to be detected cannot be reliably and selectively detected by removing the noise components.

(2) Since any changing area does not necessarily appear in a difference image of one intruding object, protected (e.g., covered of the above-described noise, association of a plurality of changing areas originating from one object, determination of the presence/absence, number, and types of intruding object(s) subsequent to change area extraction processing cannot be accurately performed.

(3) Some techniques of using as the like extract in accordance by an image pickup unit are determined together with to extract or the like, it is very difficult or clearly separate the number or the like from the noise. That is, it is very difficult to detect one intruder as one area in an image.

As a method of solving the above-described problems, a most successful processing scheme (Published 30 Unexamined Japanese Patent Application Nos. 3-59978, 3-59977, and 3-59976) has been proposed.

In this object association processing scheme, as shown in FIG. 1, when an intruder is expressed into a plurality of changing areas i.e., head, body, and leg areas, in a 35 difference image, corresponding change amounts between the changing area extracted at two consecutive time points are obtained by calculating feature amounts such as area and shape factors. Moving vectors between the corresponding changing areas are also calculated and it is determined that the changing areas which have similar moving vectors originate from the same object. This scheme is effective as long as one object is

the eye appeared into the same monitoring moment. In every cases, however, a changing area extracted on the basis of a difference does not necessarily correspond to a specific portion of an object.

For example, the human area

(1) Change in brightness due to illumination varia-

the like cannot be properly detected. If the block connection processing scheme fails or does not properly function as described above, serious problems are posed when it is applied to a monitoring system (display monitoring system).

In order to solve the above-described problems, a tracking means capable of tracking a moving object is employed in some cases. In the scheme using such tracking means, since a moving object is tracked, association between areas need not be performed. However, the tracking means of this scheme is used to analyze, e.g., the movement of a human being in many cases. According to the tracking method of the tracking means, a portion of the human, e.g., a marker (target) attached to an object to be measured (e.g., an arm or leg of a man), must be determined in advance. Therefore, it is impossible to successfully detect many unspecified intruders in a monitor area and track them.

As a method of tracking unspecified targets in a monitor area, the following method is also proposed. This method employs a change detecting means for detecting a changing area which changes due to the movement of a moving object such as an intruder, with a tracking means arranged for the changing area detected by the change detecting means. With this arrangement, the moving object presumed to be present in the changing area is tracked.

For example, the following tracking methods are employed by the tracking means described above.

(1) tracking changes in brightness (pixel luminance) in a tracking area;

(2) tracking a specific form in a tracking area; and

(3) determining a moving direction by calculating the correlation value between a tracking area and peripheral areas.

Since a given tracking means can track only a portion of a moving object, the following method is also proposed. In this method, after tracking processing is completed, tracking results are analyzed, and the tracking means are divided into groups in units of moving objects (i.e., the tracking means are combined in groups